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United States
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Forest
Service

Region 3

517 Gold Ave., SW
Albuquerque, NM 87102

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JUL 30 1981

TO: Forest Pest Management

Date

JUL 24 1981

WTK
pk

Subject: Pilot Project to Determine Use of Acephate Against Pandora Moth

To: Regional Forester, Region 3

In May 1981, a pilot project was conducted by Forest Pest Management and Kaibab National Forest personnel to determine the effectiveness of acephate against pandora moth, Coloradia pandora Blake, on the North Kaibab Ranger District, Kaibab National Forest. The objectives of the pilot project were:

1. To evaluate the operational effectiveness (reduction of insect populations and preventing defoliation) of an aerial application of acephate (Orthene Forest Spray®) against the pandora moth.
2. Reduce the adverse impact of the insect on the visual and recreation quality of the area.
3. Reduce the adverse effects of defoliation on the Kaibab squirrel and other wildlife.
4. Reduce potential growth loss and tree susceptibility resulting from defoliation.
5. Identify any problems associated with the mixing, timing, and formulation of acephate for use on pandora moth under field conditions in the Southwest.

Sampling: Five blocks ranging from 500 to 700 acres were established for treatment. There were three check blocks. Each block contained 15 sample clusters with three sample trees per cluster. Sample trees were open-grown ponderosa pine, about 25-50 feet tall. Two branch samples, 30-70 cm in length, were taken from the midcrown on opposite sides of the sample trees 48 hours prior to treatment, and on 5 and 15 days after treatment. The numbers of larvae per branch were recorded. Control blocks were sampled simultaneously with the treatment blocks.

Approximately 40 days after treatment (June 24 and 25), when larvae had begun to pupate, a defoliation rating was made on sample trees to determine percent of foliage saved. Defoliation was ranked as no defoliation, 1-25 percent, 26-50 percent, 51-75 percent, 76-99 percent, and 100 percent. Ratings were made on six trees per sample cluster.

Spray Application: Spray aircraft calibration specifications and spray deposit assessment were provided by Jack Barry and Patti Kinney of the Methods Application Group in Davis, California. The insecticide was



applied with a turbine-powered Air Tractor 302, flying at approximately 150 miles per hour and 20 feet above the canopy. Effective swath width was 150 feet. The nozzles used were Spraying Systems 1/8 GGA8W. Formulation of the pesticide was Orthene Forest Spray mixed at 100 pounds Orthene to 100 gallons of water and 1 pound Rhodamine B dye applied at 1 pound Orthene (.75 active ingredient) per acre. Application rate was 1 gallon spray per acre.

Spray deposit cards were placed in the four cardinal directions under the drip line of each sample tree during treatment to determine spray deposit and droplet size.

Blocks 4 and 5 were treated on May 13, block 3 on May 14, and block 2 on May 15. Block 1 was treated on May 19. About 3 hours after blocks 2 and 1 were treated, it snowed and/or rained for extensive periods of time.

Results: Preliminary results showing the average number of larvae per branch before, and 5 and 15 days after, treatment are presented in Table 1. Results show there was approximately an average of 58 percent reduction in populations in blocks 3, 4, and 5 as compared to a 14 percent reduction in populations in the untreated blocks at 5 days post-treatment. Little additional reduction in populations was noted 15 days after treatment. The averages of blocks 1 and 2, which were subjected to rain and snow after treatment, showed only a 27 percent reduction in populations 15 days after treatment.

Table 2 shows the average defoliation for each plot. Results show the three treated plots with an average defoliation rating falling into the 1 (1-25 percent) class. The combined averages for the check blocks show a defoliation rating of 2.48, or about an average of 50 percent defoliation. The average defoliation rating of blocks 1 and 2 combined was 3.98 or almost falling within the 76-99 percent defoliation class.

Table 3 is a summary of the spray deposit data. The drop diameters and recovery in gallons per acre were as expected and within the range experienced on similar projects. The number of drops per cm^2 is a little low, but not unexpected when evaporation is taken into consideration. The consistency of the data from one block to another reflects the quality of the application.

Preliminary results show that acephate applied at 1 pound (.75 active ingredient) per acre resulted in a population reduction of about 58 percent. Defoliation of treated plots was 25 percent or less. By keeping foliage losses below 25 percent, those objectives associated with defoliation--a) reduced impact on visual and recreation quality, b) retention of crown cover for suitable wildlife habitat, and c) a reduction of possible stress and growth loss--were achieved. Adverse weather conditions, as with any similar project, had a significant impact on the effectiveness of the spray. An additive to reduce evaporation may result in more volume recovered; however, it is not known if this would result in increased insect mortality.

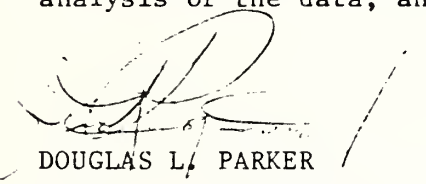
Pat Shea, Pacific Southwest Forest and Range Experiment Station, and Joseph Zinkle, University of California, Davis, monitored the effects of acephate on birds and nontarget insects.

Brain cholinesterase was monitored at pre- and post-spray in six different species of birds inhabiting the treated areas. Definite brain cholinesterase reduction was detected 2 to 3 days post-spray and at subsequent sampling up to 14 days post-spray. Additional biochemical and statistical analyses to determine how the brain cholinesterase reduction affects the birds are yet to be completed.

Monitoring for knockdown of terrestrial insects using 2 1/2' by 2 1/2' drop trays indicate very few groups of insects were affected.

John Schmid, Rocky Mountain Forest and Range Experiment Station, and Robert Young, Methods Application Group, tested a number of different sampling schemes for sampling pandora moth larval populations. Their work will identify sources of variations and make recommendations on sampling in regard to numbers of trees and branches per tree, and on the height and aspect from which the samples are taken.

A final report on this project will be issued in the fall after a complete analysis of the data, and of individual plots, can be made.



DOUGLAS L. PARKER
Director of Forest Pest Management

Enclosures (3)

Table 1

Table 2

Table 3

cc: WO (w/encls.)

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Table 1: Preliminary results of the number of pandora moth larvae per branch before treatment, and 5 and 15 days after treatment.

Block	n	Pre-spray		5-day Post-spray ^{1/}		15-day Post-spray	
		Mean	S.E.	Mean	S.E.	Mean	S.E.
Treated							
1 (5/19)	15	3.38	.15	--	--	2.75	.23
2 (5/14)	15	3.07	.37	--	--	2.34	.31
3 (5/13)	15	2.98	.25	1.46	.26	1.50	.22
4 (5/12)	15	1.14	.12	.20	.04	.33	.07
5 (5/12)	15	3.19	.42	1.40	.28	1.42	.22
Combined	5	2.75	.41	1.02	.32	1.67	.42
Untreated							
6	15	3.19	.30	2.97	.45	2.44	.30
7	15	2.53	.25	1.96	.12	2.39	.26
8	15	2.84	.47	--	--	2.01	.40
Combined	3	2.85	.19	2.47	.51	2.28	.14

^{1/} Due to a delay in treatment as a result of inclement weather, 5-day post-spray samples were not taken on blocks 1, 2, and 8.

Table 2: Average defoliation ratings for treatment and check blocks in pandora moth pilot project.

Block	\bar{x} Defoliation ^{1/} rating	S.E.
Treated		
1	4.13	.22
2	3.83	.21
3	1.60	.19
4	1.09	.03
5	1.14	.06
Untreated		
6	1.91	.14
7	3.07	.32
8	2.46	.31

^{1/} Defoliation ratings were based on visual estimates of crown defoliation. Ratings represent the following percent defoliation:

- 0 = No visible defoliation
- 1 = 1-25 percent crown defoliation
- 2 = 26-50 percent crown defoliation
- 3 = 51-75 percent crown defoliation
- 4 = 76-99 percent crown defoliation
- 5 = 100 percent crown defoliation

Table 3: Spray Deposit Data Summary for Pandora Moth Pilot Project.

Drop Diameters (μm)	Spray Bolcks				
	1	2	3	4	5
Volume median	287	292	274	301	281
Mass mean	294	297	280	311	287
Number medium	147	156	143	152	148
Number mean	162	171	156	167	162
Drops per cm^2	5.63	3.67	4.35	7.12	4.38
Recovery gallon/acre	0.27	0.20	0.18	0.37	0.20

Table 1. Pandora moth larval populations and mortalities by treated and untreated blocks, North Kaibab, Arizona, 1981.

Block	Larval densities per branch means and standard errors ¹						Unadjusted mortalities ^{2 3}	
	Pre spray		5-day post		15-day post		5-day	15-day
	mean	S.E.	mean	S.E.	mean	S.E.	post	post
 Larvae per branch. Percent . . .	
Treated								
1	3.38	.15	--	--	2.75	.23	--	18.6
2	3.07	.37	--	--	2.34	.31	--	23.8
3	2.98	.25	1.46	.26	1.50	.22	51.0	49.7
4	1.15	.11	.20	.04	.33	.07	82.6	71.3
5	3.19	.42	1.39	.28	1.41	.22	56.4	55.8
Combined	2.75	.41	--	--	1.67	.42	--	39.3
Untreated								
6	3.19	.30	2.97	.45	2.44	.30	6.9	23.5
7	2.53	.25	1.96	.12	2.39	.26	22.5	5.5
8	2.84	.47	--	--	2.01	.40	--	29.2
Combined	2.85	.19	--	--	2.28	.14	--	20.0

1 Standard errors for blocks are based on 15 clusters. Standard errors for the "combined" level are based on the block averages using 5 and 3 values respectively.

2 Unadjusted mortalities are computed using block means with the following formula:

$$\text{mortality} = (1.0 - \frac{\text{post}}{\text{pre}}) \cdot (100)$$

3 The 15-day post spray adjusted mortality values, based on Abbott's formula is 24.1 percent.

$$\text{Adj. mortality} = \left(1.0 - \left(\frac{\text{post spray treated}}{\text{pre spray treated}} \times \frac{\text{pre spray untreated}}{\text{post spray untreated}} \right) \right) \times (100)$$

PANDORA MOTH PILOT PROJECT
Cluster level means

Block 1

cluster	larvae per branch		mortality ¹	spray deposition results		
	pre spray	15-day post		VMD	gal/acre	No. of drops/cm ²
1	4.8	2.4	.50	322	.52	4.3
2	2.9	3.5	.0a	298	.55	11.0
3	2.9	2.4	.17	294	.47	8.7
4	2.6	2.7	.0a	295	.16	2.7
5	3.4	2.8	.18	333	.38	3.9
6	3.1	1.7	.45	245	.11	3.1
7	3.1	3.4	.0a	314	.31	5.8
8	3.6	5.2	.0a	324	.04	2.6
9	3.6	2.6	.28	237	.21	5.4
10	3.7	2.4	.35	330	.10	1.8
11	3.6	2.1	.42	235	.27	8.8
12	3.3	1.8	.45	297	.21	4.3
13	4.2	2.8	.33	274	.30	7.6
14	2.8	1.9	.32	226	.38	12.2
15	3.1	3.6	.0a	160	.03	2.5
Ave	3.38	2.75	.186	287	.27	5.6
S.E.	.15	.23	-			

¹Mortality = $(1 - \frac{\text{post}}{\text{pre}})$ "a" indicates that post spray larval counts were higher than pre spray larval counts.

Dates: pre-spray sample 5/14/81 spray 5/19/81 am
 15-day post spray 5/31/81
 rain 5/19/81 pm snow 5/20/81

PANDORA MOTH PILOT PROJECT
Cluster level means

Block 2

cluster	larvae per branch		mortality ¹	spray deposition results		
	pre spray	15-day post		VMD	gal/acre	No. of drops/cm ²
1	1.4	1.8	.0a	254	.05	1.1
2	5.9	4.7	.20	287	.06	1.6
3	2.2	1.1	.50	290	.15	2.2
4	4.1	3.0	.27	329	.08	1.8
5	3.9	2.3	.41	197	.01	0.9
6	4.7	2.6	.45	250	.03	0.9
7	2.3	2.1	.09	337	.06	1.4
8	5.3	2.4	.55	305	.27	4.2
9	3.7	1.2	.68	310	.51	6.1
10	1.9	1.3	.32	290	.51	8.5
11	1.8	1.3	.28	284	.55	10.6
12	2.2	.7	.68	280	.61	13.1
13	2.9	4.1	.0a	152	.00	.4
14	1.2	2.5	.0a	323	.03	.7
15	2.5	4.0	.0a	290	.03	.6
Ave	3.07	2.34	.238	292	.20	3.7
S.E.	.37	.31	-			

¹Mortality = $(1 - \frac{\text{post}}{\text{pre}})$

Dates: pre-spray sample 5/13/81 spray 5/15/81 am
 15-day post spray 5/30/81
 rain -- snow 5/15/81 pm

PANDORA MOTH PILOT PROJECT
Cluster level means

Block 3

cluster	larvae per branch		mortality ¹	spray deposition results		
	pre spray	15-day post		VMD	gal/acre	No. of drops/cm ²
1	2.9	1.0	.66	290	.37	8.3
2	2.6	2.0	.23	209	.15	4.9
3	1.1	.9	.18	230	.11	4.4
4	3.4	1.1	.68	281	.29	5.1
5	2.0	.3	.85	245	.15	3.5
6	3.6	.8	.78	215	.20	6.4
7	2.7	1.8	.33	269	.23	9.5
8	3.2	1.7	.47	296	.24	4.6
9	2.8	1.9	.32	224	.05	1.7
10	2.2	1.7	.23	248	.05	2.1
11	2.8	1.2	.57	262	.15	3.0
12	3.4	1.6	.53	293	.22	3.7
13	2.7	.8	.70	328	.39	3.7
14	3.8	4.0	.0a	150	.01	.9
15	5.5	1.7	.69	257	.13	3.1
Ave	2.98	1.50	.497	274	.18	4.4
S.E.	.25	.22	-			

¹Mortality = $(1 - \frac{\text{post}}{\text{pre}})$

Dates: pre-spray sample 5/13/81 spray 5/14/81
 15-day post spray 5/29/81
 rain -- snow 5/15/81 pm

PANDORA MOTH PILOT PROJECT

Cluster level means

Block 4

cluster	larvae per branch		mortality ¹	spray deposition results		
	pre spray	15-day post		VMD	gal/acre	No. of drops/cm ²
1	1.2	.6	.50	308	.33	6.1
2	.9	.2	.78	319	.28	5.6
3	.9	.8	.11	227	.20	5.1
4	1.3	.7	.46	239	.23	6.0
5	1.1	.1	.91	191	.07	4.3
6	1.1	.0	1.00	332	.50	6.6
7	1.6	.5	.69	299	.40	7.5
8	1.9	.3	.84	315	.54	10.3
9	2.0	.8	.60	261	.21	5.0
10	.4	.3	.25	262	.28	7.0
11	1.2	.0	1.00	313	.31	6.1
12	.6	.0	1.00	329	.64	11.2
13	1.3	.6	.54	310	.36	4.5
14	1.0	.1	.90	332	.38	4.8
15	.8	.0	1.00	290	.87	16.7
Ave	1.15	.33	.713	301	.37	7.1
S.E.	.11	.07	-			

¹Mortality = $(1 - \frac{\text{post}}{\text{pre}})$

Dates: pre-spray sample 5/12/81 spray 5/13/81

15-day post spray 5/28/81

rain -- snow 5/15/81 pm

PANDORA MOTH PILOT PROJECT
Cluster level means

Block 5

cluster	larvae per branch		mortality ¹	spray deposition results		
	pre spray	15-day post		VMD	gal/acre	No. of drops/cm ²
1	1.4	1.1	.21	350	.28	3.2
2	3.9	1.1	.72	303	.30	4.6
3	1.9	1.1	.42	287	.21	4.0
4	3.1	2.7	.13	315	.07	1.8
5	3.6	1.0	.72	228	.22	7.0
6	3.6	.7	.81	281	.29	6.9
7	1.5	.8	.47	271	.31	5.4
8	4.8	1.9	.60	277	.25	3.5
9	2.8	2.1	.25	359	.37	2.2
10	4.8	2.6	.46	276	.03	.4
11	1.1	.3	.73	223	.24	6.4
12	7.2	3.0	.58	326	.16	1.9
13	3.5	1.7	.51	252	.10	3.0
14	3.0	.9	.70	159	.08	6.2
15	1.7	.2	.88	182	.14	7.0
Ave	3.19	1.41	.558	281	.20	4.4
S.E.	.42	.22	-	-	-	-

¹Mortality = $(1 - \frac{\text{post}}{\text{pre}})$

Dates: pre-spray sample 5/12/81 spray 5/13/81
 15-day post spray 5/28/81
 rain -- snow 5/15/81

PANDORA MOTH PILOT PROJECT
Cluster level means

Block 6

cluster	larvae per branch		mortality ¹	spray deposition results		
	pre spray	15-day post		VMD	gal/acre	No. of drops/cm ²
1	2.1	1.6	.24	Untreated block		
2	3.4	4.1	.0a			
3	3.3	1.6	.52			
4	2.6	3.1	.0a			
5	1.6	2.2	.0a			
6	3.6	1.9	.47			
7	2.4	.8	.67			
8	3.9	1.9	.51			
9	4.9	4.1	.16			
10	1.5	1.2	.20			
11	2.3	3.3	.0a			
12	4.3	1.4	.67			
13	5.3	4.6	.13			
14	2.6	2.1	.19			
15	4.1	2.7	.34			
Ave	3.19	2.44	.235			
S.E.	.30	.30	-			

¹Mortality = $(1 - \frac{\text{post}}{\text{pre}})$

Dates: pre-spray sample 5/12/81 spray --
 15-day post spray 5/29/81
 rain -- snow --

PANDORA MOTH PILOT PROJECT
Cluster level means

Block 7

cluster	larvae per branch		mortality ¹	spray deposition results		
	pre spray	15-day post		VMD	gal/acre	No. of drops/cm ²
1	2.1	3.2	.0a	Untreated blocks		
2	2.2	1.2	.45			
3	2.4	4.4	.0a			
4	1.0	.6	.40			
5	.9	1.3	.0a			
6	2.2	3.0	.0a			
7	3.9	1.9	.51			
8	2.9	3.8	.0a			
9	3.9	2.7	.31			
10	4.1	2.3	.44			
11	2.2	3.2	.0a			
12	2.7	2.3	.15			
13	2.4	1.8	.25			
14	3.2	2.1	.34			
15	1.8	2.0	.0a			
Ave	2.53	2.39	.055			
S.E.	.25	.26	-			

¹Mortality = $(\frac{1-\text{post}}{\text{pre}})$

Dates: pre-spray sample 5/13/81 spray --
 15-day post spray 5/30/81
 rain -- snow --

PANDORA MOTH PILOT PROJECT
Cluster level means

Block 8

cluster	larvae per branch		mortality ¹	spray deposition results		
	pre spray	15-day post		VMD	gal/acre	No. of drops/cm ²
1	3.7	3.9	.0a	Untreated blocks		
2	2.6	1.0	.62			
3	4.1	4.3	.0a			
4	5.0	3.9	.22			
5	4.9	3.6	.27			
6	3.2	1.8	.44			
7	2.4	1.3	.46			
8	.6	.3	.50			
9	.1	.0	.0a			
10	.2	.3	.0a			
11	.0	.4	.0a			
12	4.4	1.7	.61			
13	3.2	1.7	.47			
14	3.1	2.0	.35			
15	5.1	4.0	.22			
Ave	2.84	2.01	.292			
S.E.	.47	.40	-			

¹Mortality = $(1 - \frac{\text{post}}{\text{pre}})$

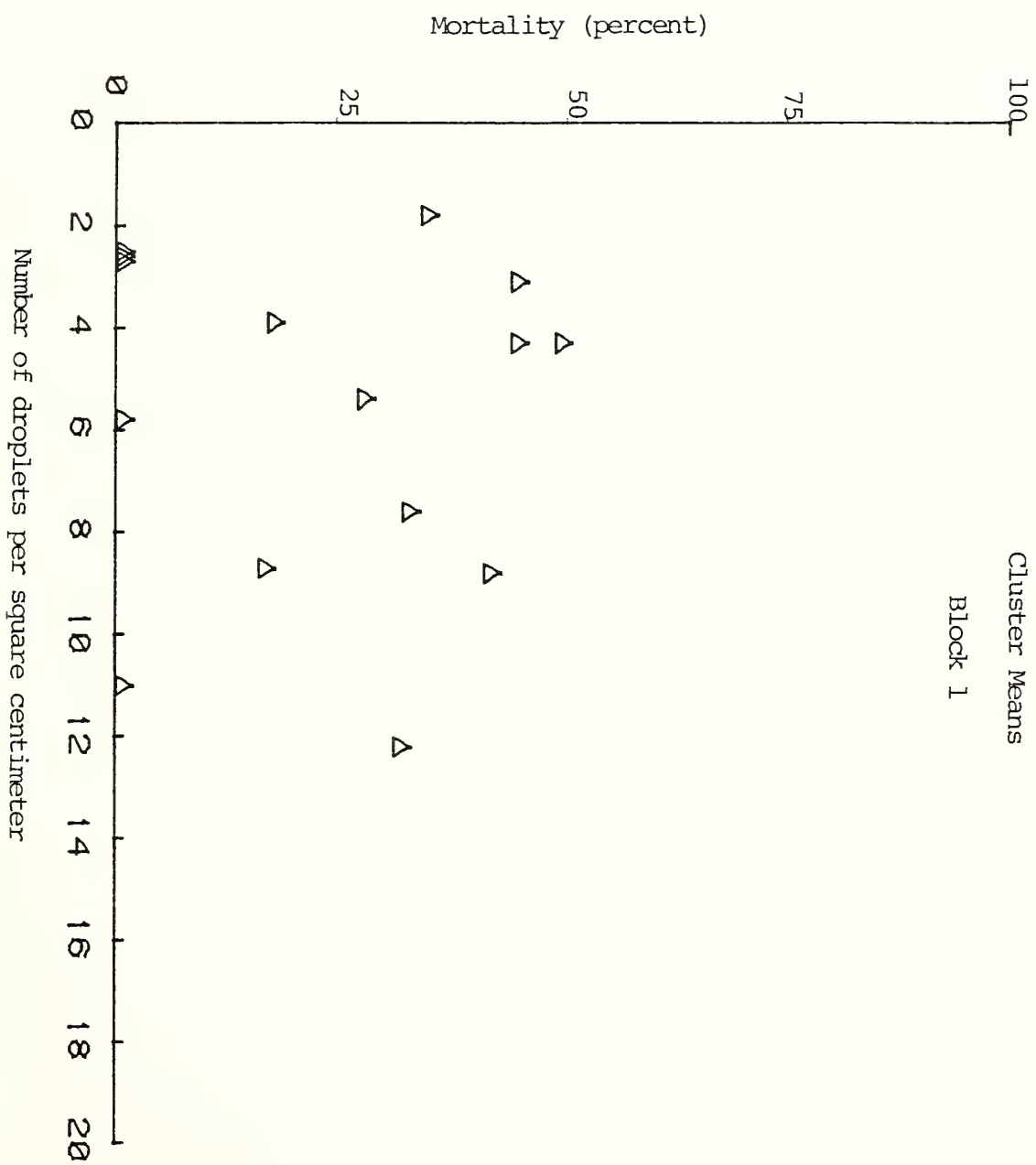
Dates: pre-spray sample 5/14/81 spray --
 15-day post spray 5/31/81
 rain -- snow --

1981 Pandora Moth Pilot Project, North Kaibab, AZ

Spray Droplets/cm² vs mortality

Cluster Means

Block 1

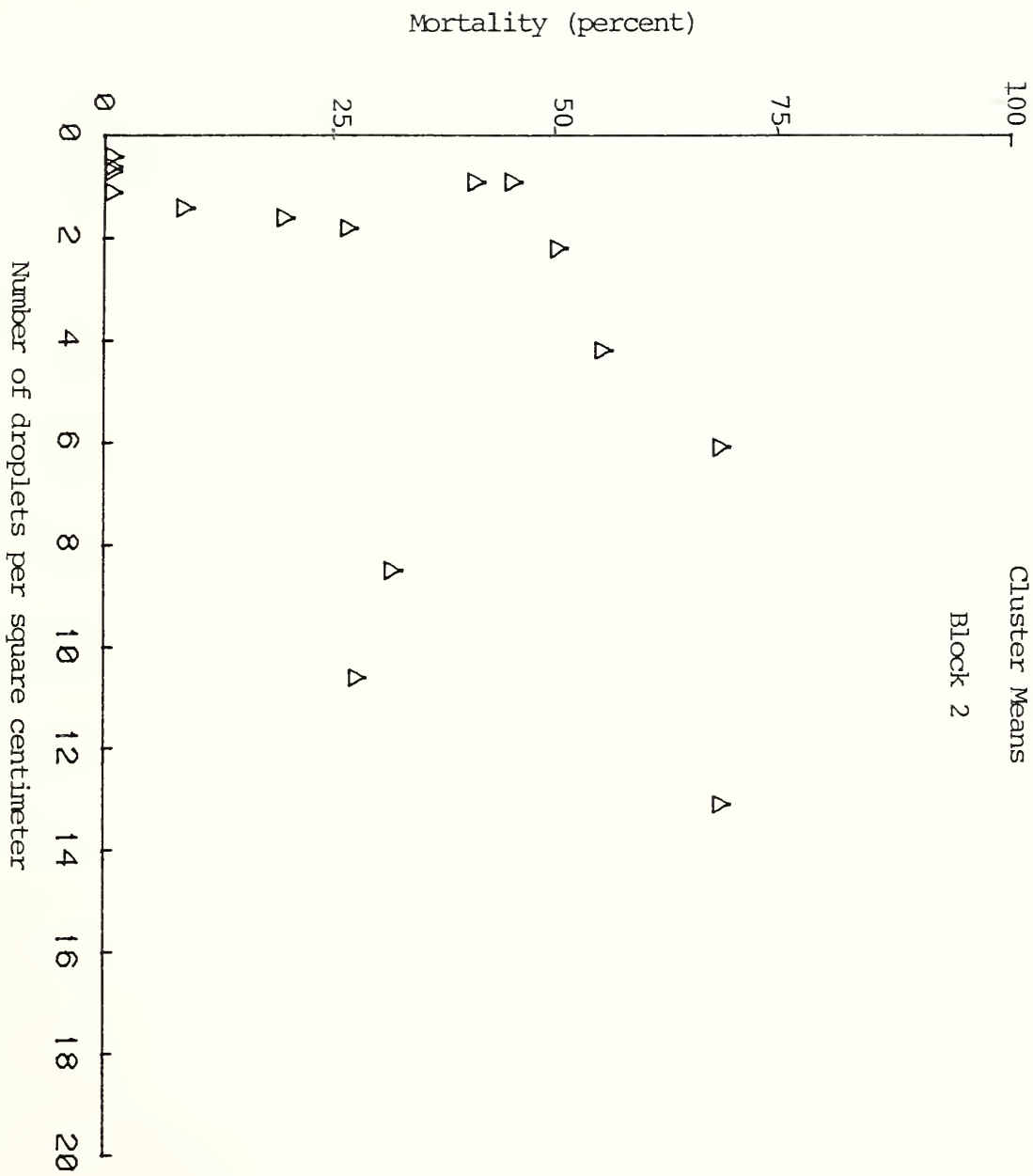


1981 Pandora Moth Pilot Project, North Kaibab, AZ

Spray Droplets/cm² vs mortality

Cluster Means

Block 2

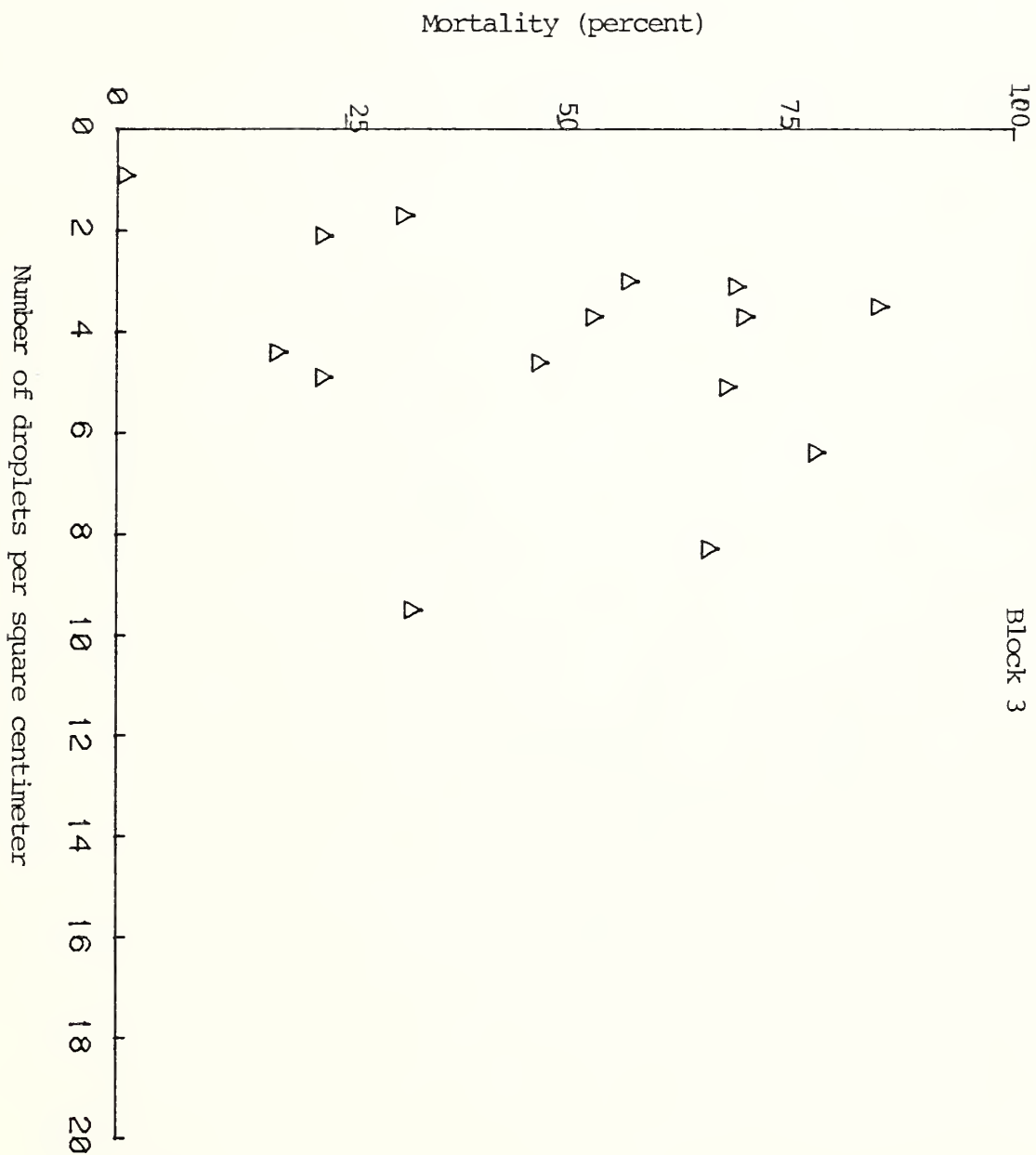


1981 Pandora Moth Pilot Project, North Kaibab, AZ

Spray droplets/cm² vs mortality

Cluster Means

Block 3

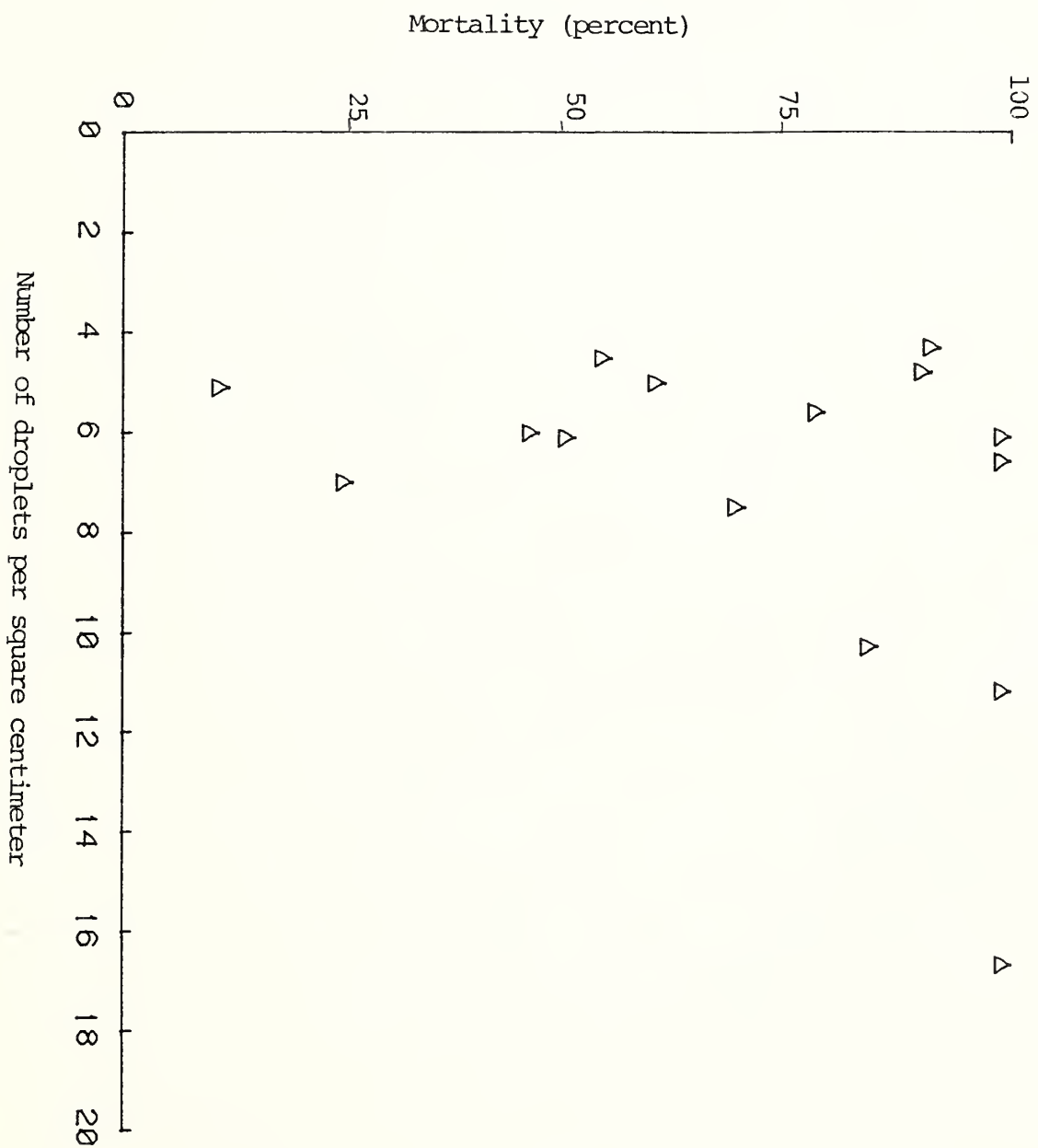


1981 Pandora Moth Pilot Project, North Kaibab, AZ

Spray droplets/cm² vs mortality

Cluster Means

Block 4

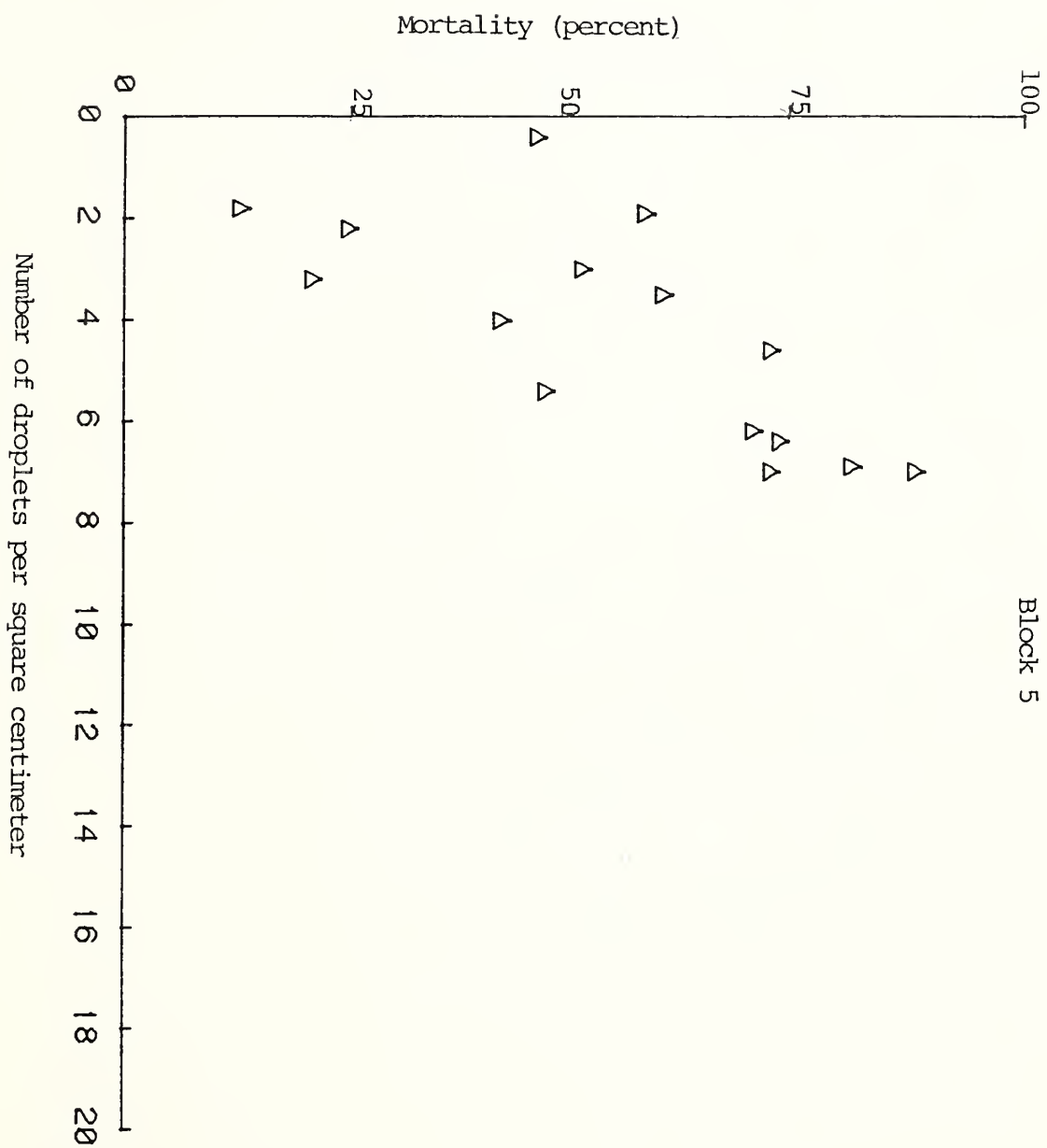


1981 Pandora Moth Pilot Project, North Kaibab, AZ

Spray droplets/cm² vs mortality

Cluster Means

Block 5

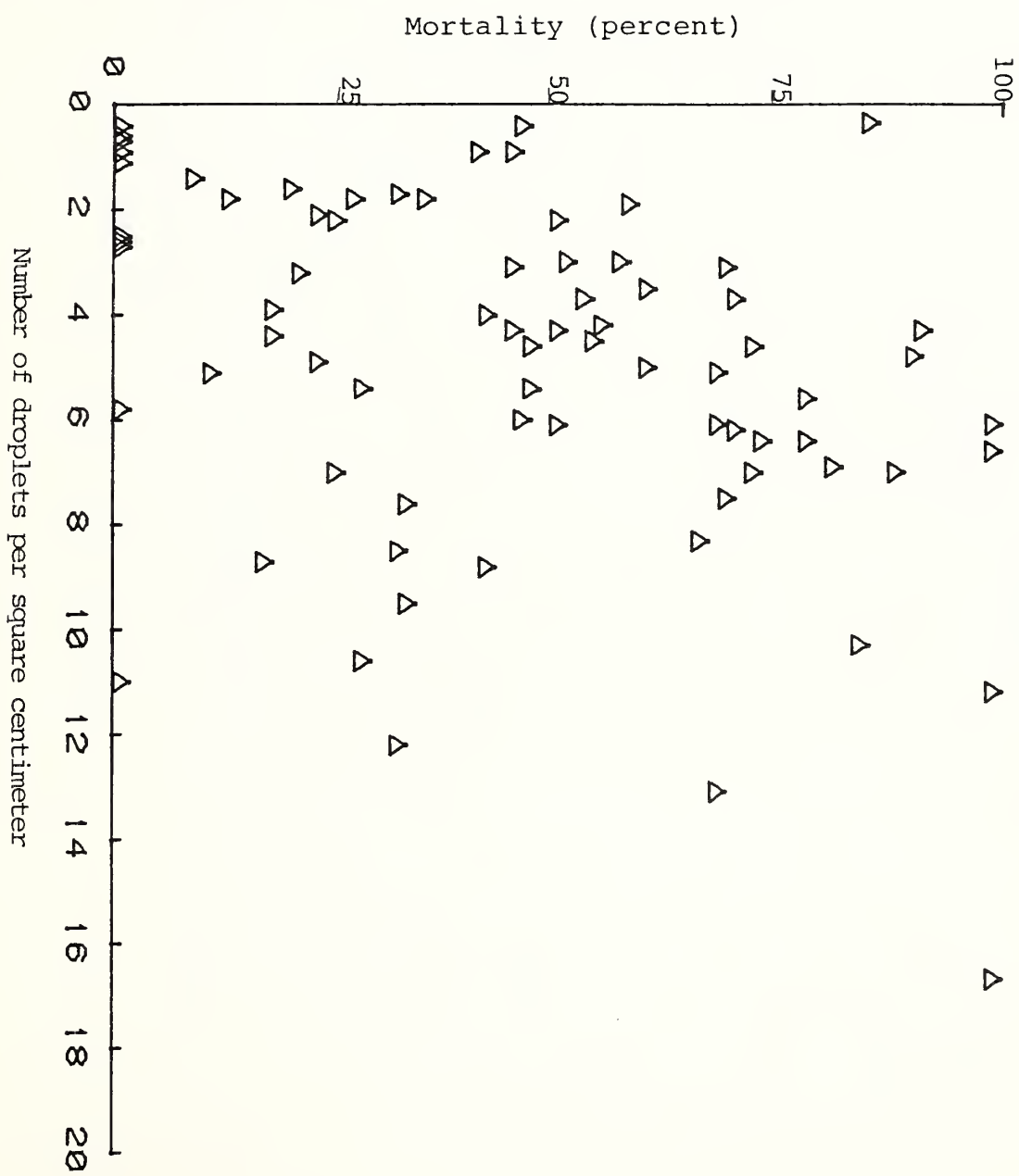


1981 Pandora Moth Pilot Project, North Kaibab, AZ

Spray droplets/cm² vs mortality

Cluster Means

Combined

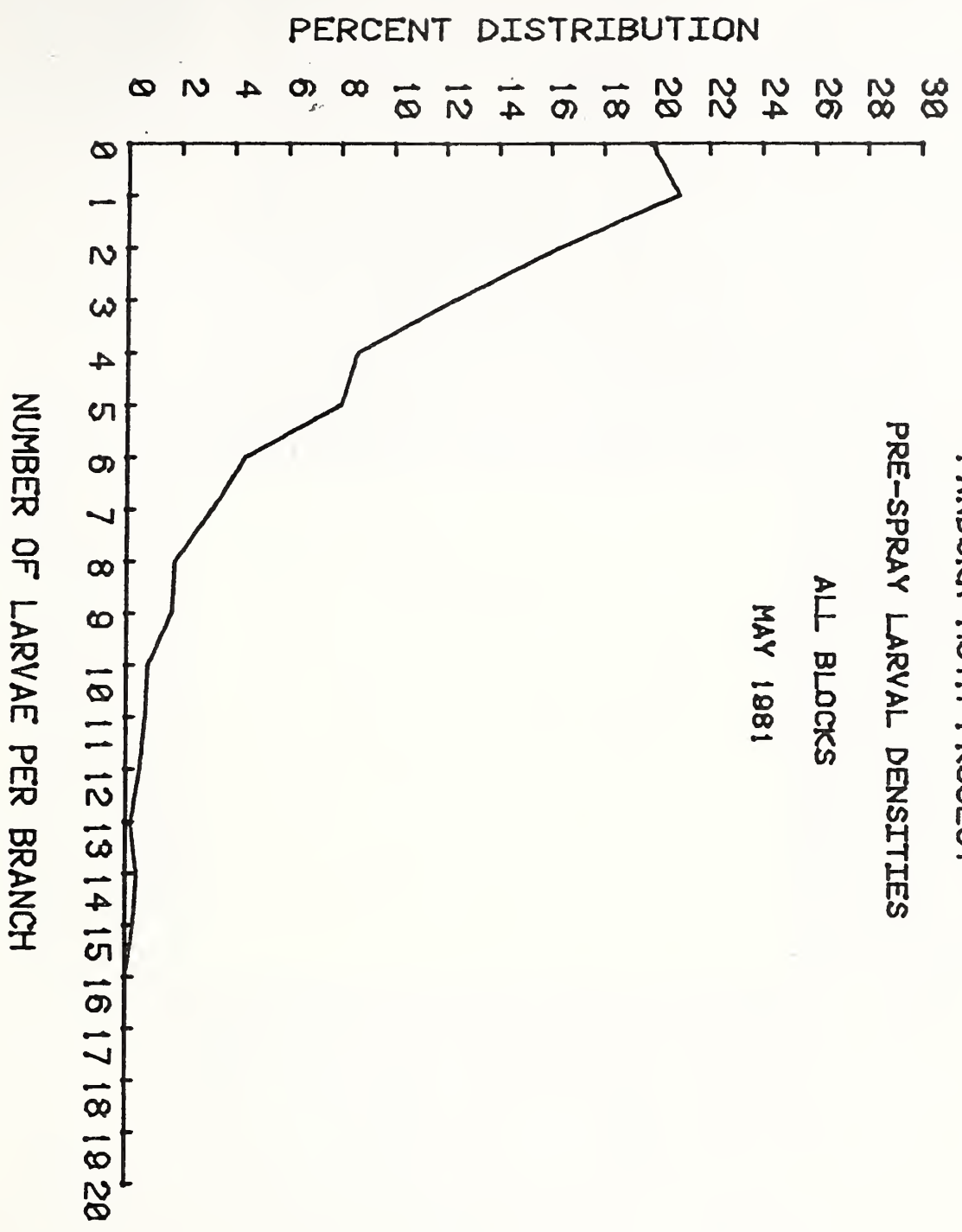


PANDORA MOTH PROJECT

PRE-SPRAY LARVAL DENSITIES

ALL BLOCKS

MAY 1981





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